



Protective Action Guides (PAGs)

October 2011

Sara D. DeCair

Environmental Protection Agency

Early Phase

- Evacuation/Shelter 1-5 rem (10-50 mSv)
- Potassium iodide (KI) 5 rem (50 mSv) projected child thyroid dose
- Worker 5, 10, 25+ rem (50, 100, 250+ mSv)



Intermediate Phase

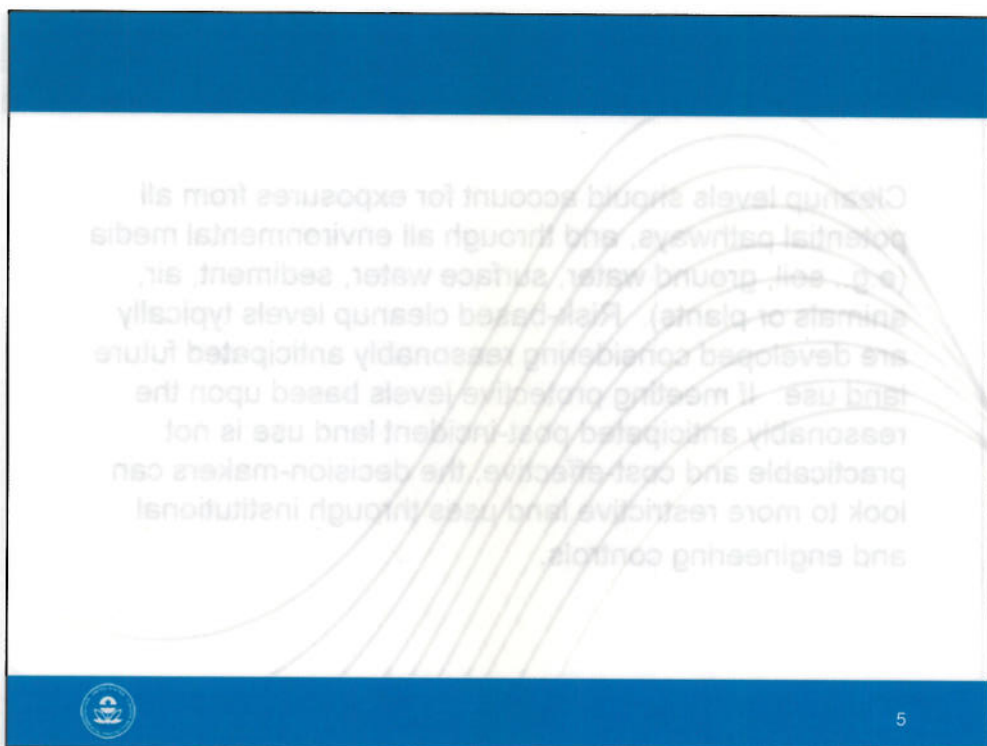
- Relocate population
 - ≥ 2 rem (20 mSv) first year (projected dose)
 - 0.5 rem (5 mSv) any subsequent year
- Apply dose reduction techniques
 - < 2 rem (20 mSv)
- Food (Food & Drug Administration 1998): Most limiting of
 - 0.5 rem (5 mSv) whole body or
 - 5 rem (50 mSv) to most exposed organ or tissue



Late Phase

- 'Late Phase' is the cleanup and restoration phase
- Not part of emergency response, so not addressed in the PAGs Manual





This approach is based on the belief that early community involvement focusing on shared post-incident uses of the property will result in expedited, cost-effective, and publicly-supported cleanups. Overall community health, including stress factors from the initial event and separation from home or family, is a necessary consideration.

In some situations, a site or area may reasonably be anticipated to support a range of uses, so cleanup goals may be different for different subuses of the site. Although it may take years to achieve the final protective cleanup levels for all land uses, re-occupation of the affected area will be possible when interim cleanup can reduce short-term risks to acceptable levels during the time it takes to achieve the long-term goals. There may be institutional or engineering controls placed on some portions of the site to restrict exposures that may be removed in the future when either further active remediation, radioactive decay, or natural weathering have succeeded in achieving cleanup goals for the reasonably anticipated land use. An example of an institutional control might be the prohibition of planting vegetable gardens in order to avoid ingesting radionuclides that are expected to be taken up by the plant roots from the soil. An example of an engineering control to limit exposures might be adding a layer of pavement or cement over gamma emitting radionuclides that have become fixed in place by sorbing onto the street and sidewalks.

In complex cases such as the situation represented by a wide area NPP RMD IWD event, cleanup and re-occupation is likely to occur subarea by subarea in order of priority and community assessments. It is likely that critical infrastructure (e.g., power plant, major highway) would be cleaned up as the first subarea. To re-establish the infrastructure as quickly as possible, a succession of increasingly protective cleanup levels might be developed to allow near-term re-use under controlled conditions while more comprehensive cleanup proceeds over the long-term. A community-based and transparent development of phases and priorities would follow resulting in action sequences, and areas (e.g., residential, commercial) would be remediated in new and reoccupied utilizing temporary cleanup levels that would be considered protective for an interim period of time prior to final cleanup levels being achieved. Land use may need to be changed in a subarea where it is not feasible with a combination of remediation, engineering and institutional controls to support the pre-incident land use in a manner that protects human health. Believe that grammatically this should be "re" referring back to community health as the subject.

Determining Cleanup Level Concentrations

Cleanup levels should account for exposures from all potential pathways, and through all environmental media (e.g., soil, ground water, surface water, sediment, air, animals or plants). Risk-based cleanup levels typically are developed considering reasonably anticipated future land use. If meeting protective levels based upon the reasonably anticipated post-incident land use is not practicable and cost-effective, the decision-makers can look to more restrictive land uses through institutional and engineering controls.



6

This approach is based on the belief that early community involvement focusing on desired post-incident uses of the property will result in expedited, cost-effective, and publicly-supported cleanups. Overall community health, including stress factors from the initial event and separation from home or family, is ~~are~~ a necessary consideration.

In some situations, a site or area may reasonably be anticipated to support a range of uses, so cleanup goals may be different for different subareas of the site. Although it may take years to achieve the final protective cleanup levels for all land uses, re-occupancy of the affected area will be possible when interim cleanup can reduce short-term risks to acceptable levels during the time it takes to achieve the long-term goals. There may be institutional or engineering controls placed on some portions of the site to restrict exposures that may be removed in the future when either further active remediation, radioactive decay, or natural weathering have succeeded in achieving cleanup goals for the reasonably anticipated land use. An example of an institutional control might be the prohibition of planting vegetable gardens in order to avoid ingesting radionuclides that are expected to be taken up by the plant roots from the soil. An example of an engineering control to limit exposures might be adding a layer of pavement or cement over gamma emitting radionuclides that have become fixed in place by sorbing onto the street and sidewalks.

In complex cases such as the situation represented by a wide area NPP/RDD/IND event, cleanup and re-occupancy is likely to occur subarea by subarea in order of priority and community assessments. It is likely that critical infrastructure (e.g., power plant, major highway) would be cleaned up as the first subarea. To re-establish the infrastructure as quickly as possible, a succession of increasingly protective cleanup levels might be developed to allow near-term re-use under controlled conditions while more comprehensive cleanup proceeds over the long-term. A community-based and transparent development of phases and priorities would follow, resulting in action sequences, and areas (e.g., residential, commercial) would be remediated ~~in turn~~ and reoccupied utilizing temporary cleanup levels that would be considered protective for an interim period of time prior to final cleanup levels being achieved. Land use may need to be changed in a subarea where it is not feasible with a combination of remediation, engineering and institutional controls to support the pre-incident land use in a manner that protects human health.

Believe that grammatically this should be "is" referring back to community health as the subject.

Cleanup Action Selection Criteria

After the protectiveness criteria and land use decisions are applied, other criteria should be considered in determining cleanup alternatives.



7

These criteria are factors with which tradeoffs between alternatives are assessed so that the best option will be chosen, given area or site-specific data and conditions. The long term protectiveness goal would help frame and guide the public discussions and community-based process. Consideration of overall health and local risk acceptance will be key components in a fully transparent approach to clean up.

Stakeholder Involvement

Any cleanup approach must include a meaningful role for communities by including opportunities for document review, public comment and full participation.

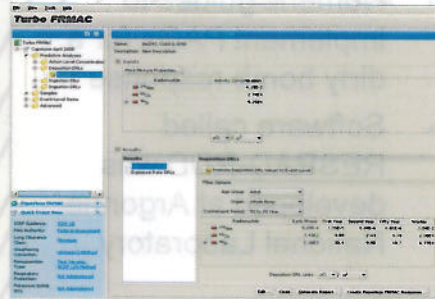


8

The federal government should seek to bring together early in the process a broad group of stakeholders, e.g., residents, local business owners, local government officials and others, who are interested in the work going on at the site in their community. The credibility of a community group is a function of its inclusiveness. It must represent all stakeholder interests in order to ensure it is a voice for the entire community rather than a few interested parties. The local community will need to be involved until the site remediation activities are complete, and possibly beyond that if institutional and engineering controls are placed on some subareas of the site.

Use the Best Available Guides & Tools

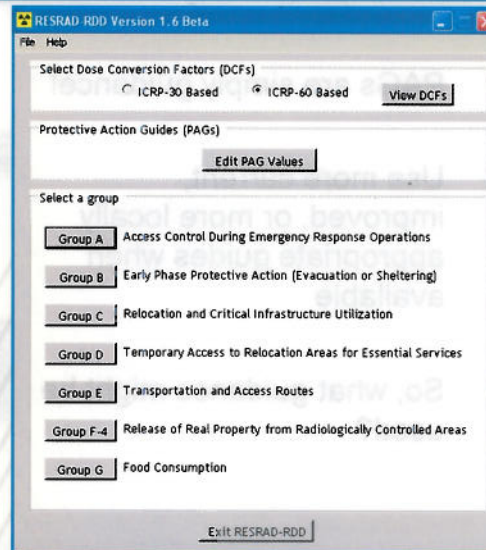
- PAGs are simply guidance!
- Use more current, improved, or more locally appropriate guides when available
- So, what guidance might be used?



Use the Best Available Guides & Tools

- Operational Guidelines
- Numeric guides to implement PAGs for a dirty bomb response
- Software called RESRAD-RDD was developed at Argonne National Laboratory

<http://ogcms.energy.gov/review.html>



Questions?



